REMARKS

Preliminarily, Applicants respectfully request the Examiner to acknowledge their claim for foreign priority and receipt of the certified copy of the priority document (from the International Bureau). The certified copy of the priority document has a PAIR mailroom date of June 10, 2008.

The amendment to claim 1 which further characterizes the thickness of the various barrier layers find support at page 8, lines 13-22 of the specification.

Review and reconsideration on the merits are requested.

Claims 1-4 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. 6,975,660 to Johnson in view of U.S. Patent 5,900,642 to Nakatsu et al. The grounds for rejection remain substantially the same as set forth in the previous Office Action.

In the Response to Arguments at pages 5-7 of the Office Action, the Examiner comments as follows.

(a) The Examiner relies on Fig. 9 of Nakatsu et al as disclosing a multiple quantum well structure in which both end layers of the light-emitting layer are barrier layers.

(b) Although present claim 1 recites that the second end layer is thicker than the barrier layer of the first end layer, "the claim limitation does not have any evidence of criticality." In view thereof, the Examiner concluded that it would have been obvious to optimize the second barrier layer of the prior art so as to be thicker than the barrier layer of the first end layer.

(c) Claim 1 does not recite the effect due to the structure in which both end layers of the light-emitting layer are barrier layers, namely, that dispersion of carriers toward the n-type and p-type clad layers is prevented more effectively.

(d) Because Applicants have not presented evidence of criticality in increasing the thickness of each of the barrier layers from the first end layer toward the second end layer (claim 2), the Examiner concluded that the subject claim limitation "has been optimized."

(e) Because Applicants have not presented evidence of criticality in an arrangement where the second end layer has an impurity concentration low at is junction portion relative to the well layer, highest at is central portion and reduced gradually from the central portion toward the p-type clad layer (claim 3), the Examiner concluded that the subject claim limitation "has been optimized."

Applicants respectfully traverse. The Examiner's comments are addressed in turn, as follows.

(a) In Fig. 9 of Nakatsu et al, the layers identified by the Examiner as being barrier end layers are actually upper and lower clad layers, respectively. Contrary to the Examiner's suggestion, within the active layer, both end layers are well layers. Further, there is no description in Nakatsu et al to the effect that the upper and lower clad layers of Fig. 9 emit light, such that the subject clad layers are <u>not</u> part of the light-emitting layer (active layer). Thus, because the upper and lower clad layers are not part of the light-emitting layer, Fig. 9 of Nakatsu et al does not show first and second end layers <u>of the light-emitting layer</u> as being barrier layers as required by present claim 1. From a different perspective, if the upper and lower clad layers

shown in Fig. 9 are taken as the first and second end layers of the light-emitting layer, then Fig. 9 does not show a first end barrier layer opposed to an n-type clad layer and a second end barrier layer opposed to a p-type clad layer.

Notwithstanding the foregoing, claim 1 has been amended to recite that the barrier layers other than the second end layer have a thickness of 15 nm or more and 50 nm or less, and that the second end layer has a thickness of 1.2 or more times and 2.5 or less times the thickness of the barrier layers other than the second end layer, to thereby clearly distinguish over lower clad layer 22 (asserted by the Examiner to be a barrier layer) shown in Fig. 9 of Nakatsu et al having a thickness of 1.5 nm and an upper clad layer 24 (asserted by the Examiner as being a barrier layer) similarly having a thickness of 1 μm as described at col. 11, lines 38-54.

Moreover, in Fig. 9 of Nakatsu et al, the lower clad layer has a greater thickness than the upper clad layer. Namely, Nakatsu et al neither discloses nor suggests the feature of claim 1 which specifies that the second end barrier layer has a greater thickness than the other barrier layers.

For these reasons alone, it is respectfully submitted that the amended claims are patentable over Johnson in view of Nakatsu et al.

(b) Applicants' specification does show criticality in setting the thickness of the second barrier layer (21n) to be thicker than the barrier layer (21n) of the first end layer. Specifically, in Example 1 at pages 16-19 of the specification, the thickness of each of the five Si-doped 2aN barrier layers 21 except for the other end layer 21n was set to 15 nm, whereas the Si-doped 2aN barrier layer forming the other end layer 21n was set to 20 nm in thickness which

was larger than those of the other barrier layers (page 17, line 33-page 18, line 3 of the specification). In the Comparative Example at pages 19-20, the same LED was prepared, except that the other end layer (21n) was made of an Si-doped 2aN barrier layer having the <u>same</u> thickness as the other barrier layers. The respective devices were then evaluated in which a forward current of 20 nA was allowed to flow through the subject LED chips. Although the light-emitting wave length of the LED chips of Comparative Example is the same as that of the LED chips of Example 1, the light-emitting output was reduced from 8.7 mW to 5.9 mW. Further, the device of the Comparative Example did not reach the characteristics of the LED of Example 1 (i.e., a near-ultraviolet LED of high light-emitting output).

(c) The merit of forming both ends of the light-emitting layer with barrier layers is described at page 3, lines 26-31 of the specification, reproduced below as follows.

> **According to the present invention, in the light-emitting layer of the multiple quantum well structure, layers forming both ends of the light-emitting layer are barrier layers. Thus, it is possible to suppress the dispersion of carrier toward the clad layer, and since carrier is enclosed with the well layer, the light emitting output can be enhanced.**

The claims need only recite the structure/composition of the device giving rise to its various effects. There is no requirement to recite the effect of the invention in the claim itself.

(d) The effect of using a barrier layer whose thickness is gradually increased is discussed bridging pages 8-9 of the specification. Example 2 at pages 20-21 describes preparation of such a device, providing a light-emitting output as high as 8.9 mW as in Example 1.

(e) Example 3 at pages 21-22 describes preparation of a device in which the impurities are distributed as claimed in claim 3. LED chips formed in this manner exhibited a low forward voltage of 3.2 V and a high light-emitting output of 8.6 mW.

Besides Example 3, the effect of the device in which impurities are distributed as defined in claim 3 is described at page 4, lines 15-22; at page 9, lines 8-17; and page 11, lines 1-3 of the present specification.

The effect of the pn junction type Group III nitride semiconductor light-emitting device of claim 4 is described at page 4, lines 23-26 and page 11, lines 21-30 of the present specification.

Applicants further comment as follows.

(i) With regard to the Examiner's assertion that the subject claim limitations discussed in (d) and (e) above "have been optimized," <u>it is the Examiner's burden</u> to first show that a particular parameter is recognized in the art as a result-effective variable before determining that the optimum or workable ranges thereof might be characterized as "routine experimentation." The Examiner repeatedly asserts that the various claim limitations "have been optimized," yet points to nothing in the prior art which suggests these structural features in the first instance.

(ii) In Johnson, nitrogen is added to the well layers to the extent that the characteristic of the crystal structure of the InGaAsSb semiconductor is not compromised. In contrast, both well layers and the barrier layers constituting a semiconductor light-emitting device of the

present invention are both formed of a Group III nitride semiconductor. Thus, they differ in composition from those disclosed by Johnson.

More importantly, Johnson does not disclose the feature of amended claim 1 which defines the barrier layers other than the second end layer as having a thickness of 15 nm to 50 nm.

Moreover, Johnson does not disclose the features of claims 2-4 of the present application.

(iii) In the semiconductor light--emitting device disclosed in Figure 9 of Nakatsu et al, the composition of the quantum well layers is $Zn_{1-x}Cd_xS$ ($0 \leq x \leq 1$) and the composition of the barrier layers is ZnSe (claim 2).

The quantum well layers and the barrier layers composing the semiconductor light-emitting device disclosed in Figure 9 of Nakatsu et al are entirely different in composition from those constituting the VCSEL of Johnson. Further, both Johnson and Nakatsu et al do not disclose a semiconductor light-emitting device comprised of well layers and barrier layers which are formed of a Group III nitride semiconductor.

Regarding this last point, in Johnson, barrier layers can be comprised of GaAsN, GaAsB or AlGaAs, whereas confinement layers can be comprised of AlGaAs which is not a Group III nitride semiconductor. In Nakatsu et al, both the well and barrier layers are not formed of a Group III nitride semiconductor.

Aside from the above differences in structure, the growth conditions and lattice constants are largely different when the composition of the semiconductor is varied. The instant invention, therefore, is not what could have been accomplished by a person skilled in this field of art at the

time of the filing of the present application by conducting "routine experimentation" based on what is disclosed by Johnson and Nakatsu et al.

For the above reasons, it is respectfully submitted that the amended claims are patentable over Johnson in view of Nakatsu et al, and withdrawal of the foregoing rejection under 35 U.S.C. § 103(a) is respectfully requested.

Withdrawal of all rejections and allowance of claims 1-4 is earnestly solicited.

In the event that the Examiner believes that it may be helpful to advance the prosecution of this application, the Examiner is invited to contact the undersigned at the local Washington, D.C. telephone number indicated below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

Abraham J. Rosner
Registration No. 33,276

SUGHRUE MION, PLLC
Telephone: (202) 293-7060
Facsimile: (202) 293-7860

WASHINGTON OFFICE
23373
CUSTOMER NUMBER

Date: June 9, 2009